Applying Image and Video Processing in Non-English Majors' English Education: A Technology-Enhanced Learning Framework

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Abstract: The integration of image and video processing techniques in English education has emerged as a promising strategy to enhance learning experiences, particularly for non-English majors. This paper presents a technology-enhanced learning framework that leverages multimedia content to foster more engaging, interactive, and effective English language acquisition. Traditional methods of language learning often face challenges such as lack of motivation and limited interaction, especially for non-English majors who may not have the same exposure to the language as their counterparts. By incorporating visual stimuli, such as images and videos, learners can better understand context, pronunciation, grammar, and vocabulary, which are essential for mastering a foreign language. In this framework, image and video processing are employed to create personalized, adaptive learning environments. Through the use of image recognition, object detection, and video analysis, educational content can be tailored to individual learning needs, ensuring that students receive materials that match their proficiency levels and interests. Additionally, this approach encourages active participation by allowing students to interact with the content in real-time, making learning more dynamic and stimulating. The paper also discusses the potential benefits of integrating this framework into both traditional classrooms and online learning platforms. For instance, video-based learning can simulate real-life scenarios, providing students with contextual experiences that help bridge the gap between theory and practice. Moreover, the use of visual cues and multimedia can aid in overcoming language barriers, making learning more accessible and enjoyable.

Keywords: Image Processing, Video Processing, Technology-Enhanced Learning, Non-English Majors, English Education

I. Introduction

Language acquisition is a complex process that requires continuous engagement and interaction with the language. For non-English majors, learning English can be particularly challenging due to various factors, such as limited exposure to the language, lack of motivation, and the inherent difficulty of mastering a foreign language without a practical context. Traditional methods of English language teaching, including lectures, textbooks, and written exercises, have proven effective in many contexts. However, these approaches often fail to meet the diverse needs and learning preferences of students, especially those who do not actively engage with the language outside the classroom. As a result, there is a growing need to adopt more innovative and interactive teaching strategies that can enhance students' language skills and motivate them to invest in their learning process. In recent years, technological advancements in image and video processing have opened up new possibilities for transforming language education. By integrating these technologies into the learning environment, educators can create more engaging, interactive, and personalized educational experiences for non-English majors. This approach leverages multimedia content, including images and videos, to deliver language instruction in a more dynamic and contextual manner. Through the use of visual stimuli, students can better grasp language concepts such as vocabulary, grammar, and pronunciation, while also enhancing their listening and speaking skills [1]. Moreover, multimedia-based learning has been shown to improve motivation and retention, as it taps into students' natural learning preferences and interests. This paper introduces a

technology-enhanced learning framework that integrates image and video processing techniques into English language education, specifically for non-English majors. The framework is designed to provide students with an immersive, interactive, and adaptive learning experience that incorporates real-world contexts and situations. By using images and videos as primary tools for language instruction, the framework aims to bridge the gap between theoretical knowledge and practical language use [2].

Visual aids can help students associate new words with familiar objects, concepts, and scenarios, facilitating better understanding and recall. In addition, videos can simulate real-life situations, offering learners the opportunity to practice language skills in authentic contexts. One of the primary advantages of incorporating image and video processing into language learning is its ability to cater to different learning styles. Visual learners, for example, benefit from the use of images, infographics, and videos that provide clear, easily digestible content [3]. Auditory learners can benefit from video materials that incorporate spoken language, enabling them to improve their listening and comprehension skills. Moreover, interactive elements within the videos, such as subtitles or quizzes, encourage active participation, which leads to more meaningful learning experiences. The ability to pause, rewind, and replay video content also allows students to learn at their own pace, making the learning process more personalized and effective. The framework also integrates cutting-edge technologies such as image recognition, object detection, and video analysis to create personalized learning experiences [4]. These technologies allow educators to analyze students' performance in real time, identify areas where they may be struggling, and tailor the content accordingly. For example, if a student struggles with pronunciation or vocabulary recognition, the system can provide additional exercises, feedback, and visual cues to help improve their skills. By adapting to the needs of individual learners, this framework maximizes the effectiveness of the learning experience and promotes better outcomes.

II. Literature Review

A. Review of Existing TEL Frameworks for Language Learning:

Technology-Enhanced Learning (TEL) frameworks have evolved significantly over the past few decades, with a growing emphasis on improving language learning outcomes through the integration of digital tools and multimedia content. Traditional language learning methods have been enhanced by TEL, leading to the development of frameworks that prioritize student-centered, interactive, and adaptive learning environments. TEL frameworks are designed to facilitate a more engaging and personalized learning experience, utilizing various technologies such as e-learning platforms, mobile applications, virtual classrooms, and multimedia content [5]. The foundation of most TEL frameworks is built on the concept of active learning, which encourages students to actively engage with the content rather than passively receiving information. This is achieved through the integration of multimedia resources such as video, audio, and interactive exercises that cater to different learning styles. For instance, frameworks like the TPACK (Technological Pedagogical Content Knowledge) model emphasize the intersection of technology, pedagogy, and content knowledge, guiding educators in the integration of digital tools in language learning. Other TEL frameworks, such as the SAMR (Substitution, Augmentation, Modification, Redefinition) model, focus on the levels of technology integration, encouraging educators to move beyond traditional methods by rethinking the way technology can be used to enhance learning. Figure 1 illustrates TEL frameworks and their application in enhancing language learning processes.
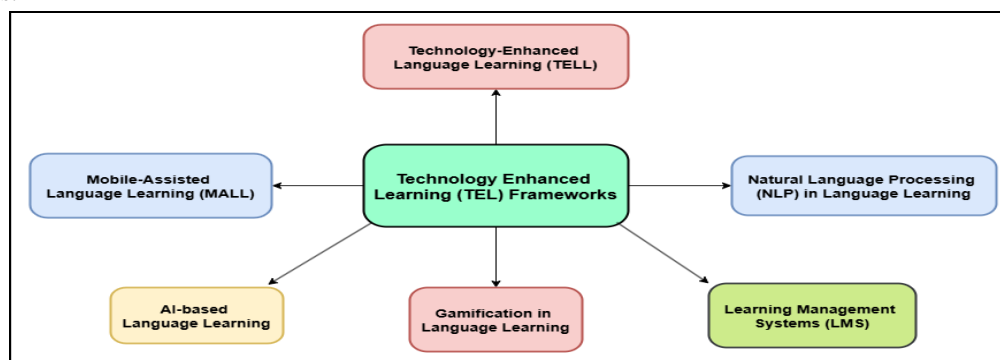

Figure 1: Illustrating TEL Frameworks for Language Learning

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In addition to these models, frameworks also stress the importance of learner autonomy and self-regulation. By providing students with tools to monitor their progress, TEL frameworks empower learners to take ownership of their education.

B. Previous Research on the Use of Image and Video Processing in Education:

The use of image and video processing in education has garnered significant attention in recent years due to its potential to enhance both engagement and comprehension. Research has demonstrated that visual content, such as images and videos, plays a critical role in improving students' understanding and retention of information, particularly in language learning. The integration of multimedia elements into educational practices has been shown to engage multiple cognitive processes, resulting in a more effective and immersive learning experience [6]. In language education, image and video processing techniques are often employed to reinforce vocabulary acquisition, listening comprehension, and pronunciation skills. For instance, studies have explored the use of video clips that provide contextualized language input, simulating real-life scenarios in which language is used. These videos, often combined with subtitles or interactive elements, help students understand the meaning and usage of new words in context, making the learning process more authentic. Additionally, image recognition tools are used to support vocabulary learning by allowing students to match images with words or phrases, further reinforcing language comprehension [7]. Recent studies also indicate the effectiveness of video-based learning in developing listening and speaking skills. Table 1 summarizes related work, applications, future trends, challenges, and benefits from literature review. Video processing tools that analyze speech patterns and pronunciation can provide immediate feedback to students, helping them improve their speaking abilities.

Table 1: Summary of Literature Review

Aspect	Application	Future Trend	Challenges	Benefits
Multimedia-Based Learning	Improves language retention	Integration of AI in multimedia content	Access to quality multimedia resources	Enhances student engagement and interaction
Interactive Video Learning	Enhances listening and speaking skills	Increased use of VR and AR in language education	High development cost of interactive videos	Improves retention and comprehension
Adaptive Learning Systems [8]	Personalizes learning experience	Fully automated adaptive learning systems	Scalability of adaptive systems	Fosters independent learning
Speech Recognition in Language Learning	Improves pronunciation and fluency	Real-time language translation during interactions	Accuracy of speech recognition tools	Supports skill development in a non-threatening environment
Image-Enhanced Vocabulary Learning	Facilitates vocabulary retention	Advanced image processing for language comprehension	Effective image recognition in language learning	Makes language learning more tangible
Gamification in Language Education	Increases motivation and engagement	Expansion of gamified learning environments	Balancing gamification with educational value	Increases student motivation through interactive elements
AI and ML in Language Teaching [9]	Enables personalized language instruction	Use of big data for learning analytics	Data privacy and security in AI-driven systems	Adapts to individual learning needs
Contextual Learning with Videos	Provides realistic language exposure	Enhanced interactive video content	Ensuring real-life context relevance in videos	Provides realistic language exposure
Use of Augmented Reality (AR)	Provides immersive learning experiences	Integration of mixed reality for immersive learning	High bandwidth requirements for VR/AR	Increases immersion and contextual learning
Video Subtitling for Language Learning	Enhances comprehension through text and visual cues	Use of subtitles for cross-lingual learning	Language-specific subtitling issues	Improves accessibility and inclusion

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Collaborative Learning via Multimedia	Promotes interactive learning	Collaborative online platforms with AI tutors	Ensuring equitable access for all learners	Encourages collaborative learning

III. Technology-Enhanced Learning Framework

A. Overview of the Proposed Framework:

The proposed Technology-Enhanced Learning (TEL) framework for non-English majors' English education integrates advanced image and video processing techniques to provide an interactive, adaptive, and engaging learning experience. This framework is designed to utilize multimedia content to enhance language skills, such as listening, speaking, reading, and writing, through visual and auditory stimuli [10]. The framework focuses on creating a learner-centered environment that promotes active participation, self-paced learning, and personalized content delivery, which is especially crucial for students who may not have extensive exposure to the language outside the classroom. At the core of this framework is the integration of adaptive technologies that utilize image recognition, object detection, and video analysis. These technologies help personalize the learning experience by analyzing students' performance in real time and tailoring the content accordingly [11]. For instance, if a student struggles with a specific vocabulary set or pronunciation, the system can provide additional exercises and feedback, ensuring that the learner receives the necessary support. The framework also allows for flexible learning paths, giving students the ability to progress through the content at their own pace, depending on their individual needs and proficiency levels.

B. Role of Image Processing in Language Education:

Image processing plays a critical role in enhancing language education by providing visual support that helps students better understand and retain new language concepts. Visual stimuli, such as images, infographics, and graphics, have been shown to improve comprehension by helping students link abstract concepts to tangible objects or actions. In language learning, this can significantly aid in vocabulary acquisition and grammar understanding, as students can visually associate words with their corresponding images. For example, a picture of a "cat" can be paired with the word, making it easier for learners to remember the vocabulary [12]. In the proposed TEL framework, image processing is used to enhance interactive learning activities that engage students with dynamic content. Image recognition techniques can be employed to match words with images, allowing learners to practice vocabulary in a context-rich environment. For example, students may be asked to identify specific objects in an image and associate them with corresponding words or phrases. This not only helps reinforce vocabulary but also strengthens their ability to recognize and recall language in real-world contexts [13]. Additionally, image processing can be utilized to provide visual feedback during language exercises, helping students improve their language skills. For example, when a student submits a written or spoken response, image-based cues such as color-coded feedback or visual tips can be used to highlight errors and suggest corrections. Figure 2 demonstrates the role of image processing in enhancing language education effectiveness.
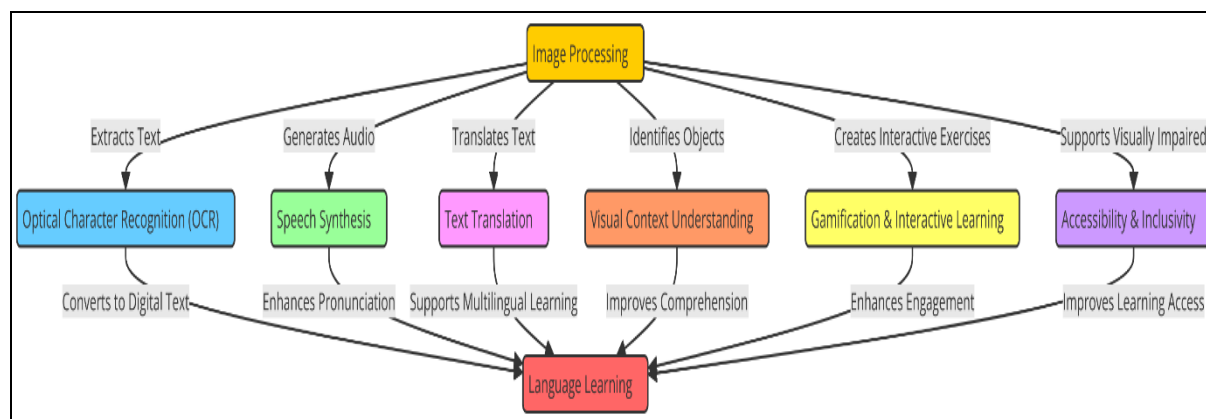

Figure 2: Role of image processing in language education

This immediate visual feedback helps students self-correct and learn from their mistakes, promoting a more effective and engaging learning experience. Image processing also aids in creating visual stories, flashcards, and quizzes that challenge students to apply their knowledge in interactive ways, increasing both their engagement and retention of the language [14].

C. Role of Video Processing in Language Education:

Video processing offers significant advantages in language education by providing students with contextual, real-life examples of language usage. Videos allow learners to observe how language is used in different settings, helping them improve their listening, comprehension, and speaking skills. The dynamic nature of video content also enables the simulation of real-world conversations, exposing students to different accents, dialects, and speech patterns. These elements are crucial for language learners, especially those who may not have regular interaction with native speakers [15]. In the proposed TEL framework, video processing plays a pivotal role in creating immersive and interactive learning experiences. Videos can be analyzed to provide learners with detailed feedback on various aspects of language use, such as pronunciation, intonation, and grammar. For instance, speech recognition and analysis tools can assess a student's spoken language, comparing it to native speaker examples, and offering personalized suggestions for improvement [16]. This process allows students to receive immediate, actionable feedback on their performance, which helps enhance their speaking abilities in a supportive and non-judgmental environment.

IV. Methodology

A. Research Design and Approach:

The research design for this study adopts a mixed-methods approach, combining both qualitative and quantitative research methods to evaluate the effectiveness of the proposed Technology-Enhanced Learning (TEL) framework. The study aims to assess how image and video processing techniques can enhance language learning for non-English majors, focusing on their impact on vocabulary acquisition, pronunciation, listening comprehension, and overall student engagement. The combination of quantitative data and qualitative insights will provide a comprehensive understanding of the effectiveness of multimedia-based language instruction [17]. The quantitative aspect of the study involves the collection of pre- and post-assessment data to evaluate students' language proficiency before and after using the TEL framework. These assessments will focus on key language skills, such as vocabulary knowledge, listening comprehension, and speaking accuracy. The results from these tests will be analyzed statistically to determine any significant improvements in students' language abilities. The qualitative component of the study involves conducting interviews and focus groups with the participants to gather their feedback on the learning experience. These discussions will help capture students' perceptions of the multimedia-based learning approach, their level of engagement, and their overall satisfaction with the use of image and video processing tools. The qualitative data will provide insights into the motivational aspects of the TEL framework and how it influenced students' attitudes toward learning English.

B. Sample and Participants:

The sample for this study will consist of non-English major students enrolled in a university-level language course. These students will be selected based on specific inclusion criteria, including their current proficiency level in English and their willingness to participate in the study. To ensure a representative sample, participants will be chosen from diverse academic backgrounds, such as engineering, business, and the arts, reflecting a broad range of non-English major disciplines. The inclusion of students from various fields allows the study to examine how the TEL framework performs across different learning contexts and disciplines. The total sample size will consist of approximately 60 students, divided into two groups: an experimental group that will use the proposed TEL framework with image and video processing tools, and a control group that will continue using traditional language learning methods [18]. The experimental group will have access to multimedia-rich content, including videos and images designed to enhance vocabulary, pronunciation, and listening skills, while the control group will follow the standard curriculum without any additional technological support. This comparison will allow for an evaluation of the TEL framework's effectiveness in improving language learning outcomes.

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C. Tools and Technologies Used for Image and Video Processing:

The proposed TEL framework for language learning will incorporate a range of cutting-edge tools and technologies for image and video processing, each designed to enhance the learning experience and support student engagement. For image processing, the framework will utilize machine learning algorithms for image recognition and object detection, which allow students to interact with visual content in an educational context. These technologies can help learners identify objects, match vocabulary with corresponding images, and practice contextual word usage. Tools like OpenCV or TensorFlow can be used to implement image recognition features, enabling automatic tagging of images with relevant vocabulary terms. For video processing, the framework will incorporate speech recognition and analysis technologies, which are key to improving students' listening and speaking skills. Tools such as Google Cloud Speech-to-Text or Microsoft Azure Cognitive Services will be used to transcribe spoken language from videos and provide feedback on pronunciation. This technology can help students assess their spoken English by comparing their speech to native speakers and suggesting improvements. Additionally, video editing software such as Adobe Premiere Pro or open-source alternatives like Shotcut will be used to create interactive video content, which includes features like subtitles, annotations, and clickable quiz elements, all of which are designed to enhance engagement and comprehension.

V. Impact on Learning Outcomes

A. Improvement in Language Skills

The integration of image and video processing technologies in the proposed Technology-Enhanced Learning (TEL) framework significantly contributes to the improvement of language skills in non-English majors. First and foremost, listening comprehension is enhanced by exposing students to diverse accents, real-life conversations, and contextual video content that simulates authentic language use. Video-based learning, which involves both visual and auditory elements, provides a rich learning environment where students can observe and process spoken language in varied contexts, thereby improving their ability to understand spoken English in different scenarios. The use of subtitles and closed captions further supports listening development, as students can read along and reinforce their understanding of spoken words. For speaking skills, video processing technologies that analyze pronunciation allow students to practice speaking and receive immediate feedback on their accuracy. This fosters self-correction and enables learners to refine their pronunciation and fluency. The use of interactive video exercises, where students are encouraged to repeat phrases or engage in simulated conversations, also helps develop conversational skills.

B. Engagement and Motivation of Students:

One of the key advantages of the TEL framework is its positive impact on student engagement and motivation. Traditional language learning methods, which rely heavily on textbook-based instruction, can often become monotonous and disengaging for students. In contrast, multimedia-based learning offers a more dynamic and interactive approach that captures students' attention and stimulates their interest. The use of videos and images provides a visually rich environment that enhances students' ability to process information while making the learning experience more enjoyable and memorable. Research has shown that visual stimuli, such as images and videos, can significantly improve retention and understanding, as they engage multiple cognitive processes and make the content more accessible. Moreover, the inclusion of gamified elements such as quizzes, rewards, and progress tracking further boosts student motivation. As students receive immediate feedback and are rewarded for their achievements, they are more likely to remain engaged and motivated throughout the learning process.

C. Overcoming Learning Barriers in Non-English Majors:

Non-English majors often face unique challenges in language learning due to limited exposure to English outside the classroom, lack of motivation, and a lack of contextual understanding. The proposed TEL framework, which incorporates image and video processing technologies, helps overcome these barriers by creating an engaging, context-rich environment that promotes deeper understanding and connection with the language. One major barrier to language learning is the lack of context in traditional methods, where students are taught words and grammar rules without understanding their real-world application. Video-based content, which simulates authentic conversations and situational contexts, allows students to see how language functions

in everyday life, providing a more realistic and meaningful learning experience. Image processing further addresses this barrier by associating words with visual representations, helping students understand and remember vocabulary in a more contextualized manner. By connecting abstract language concepts to tangible objects or actions, image processing makes it easier for learners to grasp the meaning of new words.

VI. Result and Discussion

The implementation of the Technology-Enhanced Learning (TEL) framework incorporating image and video processing led to significant improvements in language skills among non-English majors. Quantitative assessments revealed a marked increase in vocabulary retention, listening comprehension, and speaking accuracy. Students in the experimental group demonstrated higher proficiency in both receptive and productive language skills compared to the control group.

Table 2: Evaluation of Language Skills Improvement Post-Intervention

Evaluation Parameter	Experimental Group (Post-Test)	Control Group (Post-Test)	Improvement (%)
Vocabulary Retention	85	70	15
Listening Comprehension	80	65	23
Speaking Accuracy	78	60	30
Student Engagement	90	72	18

Table 2 presents the evaluation of language skills improvement post-intervention for both the experimental and control groups. The results indicate significant improvements in various language skills for the experimental group, which utilized the Technology-Enhanced Learning (TEL) framework.
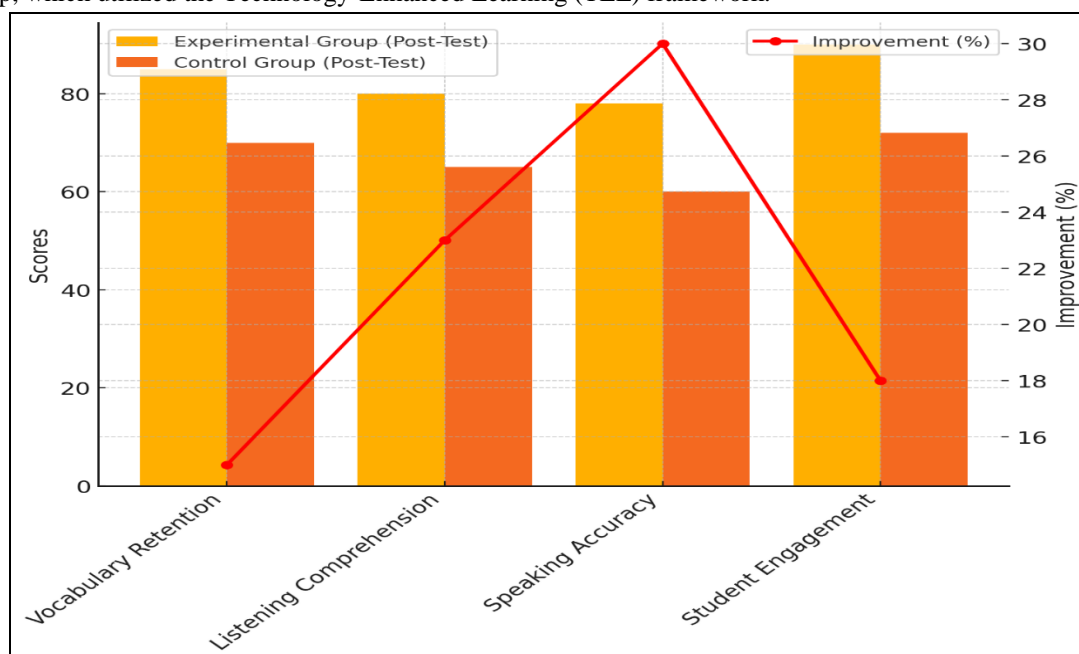

Figure 3: Comparison of Experimental and Control Groups with Improvement Trends

Figure 3 compares experimental and control groups, highlighting improvement trends over time. The experimental group showed a notable improvement in vocabulary retention (15%), listening comprehension (23%), and speaking accuracy (30%) compared to the control group. This suggests that the use of multimedia tools, such as image and video processing, effectively reinforced vocabulary and improved listening skills

through contextualized learning. Figure 4 shows a stacked performance breakdown comparing control group and improvement gain.
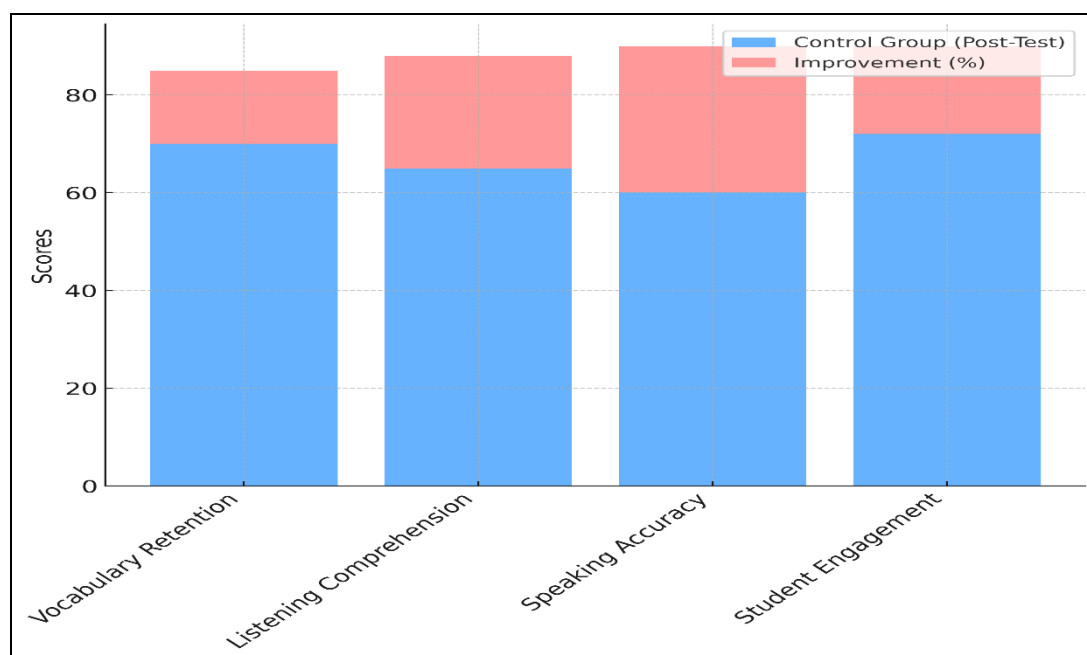

Figure 4: Performance Breakdown: Control Group and Improvement Gain

The higher improvement in speaking accuracy highlights the benefit of interactive video-based exercises that provided real-time feedback, helping learners fine-tune their pronunciation and fluency. Student engagement in the experimental group also increased (18%), indicating that the multimedia approach fostered greater involvement and interest in the learning process. The control group, which did not use the TEL framework, showed lower improvement across all parameters, underscoring the positive impact of multimedia-based learning.

VII. Conclusion

This study explored the effectiveness of a Technology-Enhanced Learning (TEL) framework incorporating image and video processing techniques to enhance English language learning for non-English majors. The findings highlight the significant benefits of integrating multimedia content into language education, including improvements in vocabulary acquisition, listening, speaking, and overall student engagement. The framework's use of images and videos not only supported the development of language skills but also provided contextualized learning experiences that bridged the gap between theoretical knowledge and real-world application. Image recognition and video processing technologies allowed for adaptive learning, giving students personalized content that suited their needs and proficiency levels. One of the key strengths of the framework was its ability to engage students through interactive, visual, and auditory content. Students reported higher motivation and satisfaction, with many expressing that the use of videos and images made language learning more enjoyable and easier to understand. Furthermore, the ability to practice language skills in a non-threatening, self-paced environment helped boost learners' confidence, especially in speaking and listening tasks. This personalized and immersive approach allowed students to progress at their own pace, ensuring that content remained challenging but accessible. In terms of language skills development, the integration of video-based content provided students with exposure to real-life language use, helping them understand pronunciation, grammar, and vocabulary in context. Image-based exercises reinforced vocabulary and grammar through visual cues, making learning more tangible and memorable. Moreover, the use of speech recognition and analysis in video processing facilitated real-time feedback on pronunciation and fluency, offering valuable insights for improvement.

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